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I HEREBY CERTIFY that annexed hereto is a true copy of documents filed in connection with the following patent application:

Application No. S2001/0416

Date of Filing 26 April 2001

Applicant RICHMOUNT COMPUTERS LIMITED, an Irish company of Maple House, South County Business Park, Leopardstown, Dublin 18, Ireland.

Dated this 2 day of October 2001.

*Coburn*  
PP An officer authorised by the  
Controller of Patents, Designs and Trademarks.

FORM NO. 1

**REQUEST FOR THE GRANT OF A PATENT**  
**PATENTS ACT, 1992**

The Applicant named herein hereby request

   the grant of a patent under Part II of the Act

  X   the grant of a short-term patent under Part III of the Act

on the basis of the information furnished hereunder.

**1. APPLICANT**

Name

Richmount Computers Limited

Address

Maple House, South County Business Park,  
Leopardstown, Dublin 18, Ireland

Description/Nationality

An Irish company

**2. TITLE OF INVENTION**

" Apparatus arranged to provide redundancy in a Serial ATA storage enclosure "

**3. DECLARATION OF PRIORITY ON BASIS OF PREVIOUSLY FILED  
APPLICATION FOR SAME INVENTION (SECTIONS 25 & 26)**

Previous filing date

Country in or for  
which filed

Filing No.

**4. IDENTIFICATION OF INVENTOR(S)**

Name(s) of person(s) believed by Applicant(s) to be the inventor(s)

1. Aedan Diarmuid Cailean Coffey
2. Timothy James Symons
3. Derek Christopher Harnett
4. Hans O'Sullivan

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- 4 Glen Cottage, Glencormac, County Wicklow, Ireland

**5. STATEMENT OF RIGHT TO BE GRANTED A PATENT (SECTION 17(2)(B))**

1, 2, 3 & 4 by virtue of a Deed of Assignment effective April 26, 2001

Contd./...

6. **ITEMS ACCOMPANYING THIS REQUEST - TICK AS APPROPRIATE**

- (i) ☒ prescribed filing fee EUR 63.49 (IR£50.00)  
(ii) ☐ specification containing a description and claims  
☒ specification containing a description only  
☒ Drawings referred to in description or claims  
(iii) ☐ An abstract  
(iv) ☐ Copy of previous application(s) whose priority is claimed  
(v) ☐ Translation of previous application whose priority is claimed  
(vi) ☒ Authorisation of Agent (this may be given at 8 below if this Request is signed by the Applicant(s))

7. **DIVISIONAL APPLICATION**

The following information is applicable to the present application which is made under Section 24

Earlier Application No: ~  
Filing Date: ~

8. **AGENT**

The following is authorised to act as agent in all proceedings connected with the obtaining of a Patent to which this request relates and in relation to any patent granted -

**Name**

F. R. KELLY & CO.

**Address**

at their address as recorded for the time being in the Register of Patent Agents

9. **ADDRESS FOR SERVICE (IF DIFFERENT FROM THAT AT 8)**

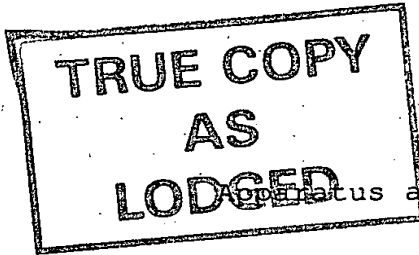
RICHMOUNT COMPUTERS LIMITED  
F. R. KELLY & CO.

By: \_\_\_\_\_

EXECUTIVE

Date: April 26, 2001

2 6 APR 2001



Apparatus arranged to provide redundancy in a Serial  
ATA storage enclosure

5 The present invention relates to apparatus arranged to  
provide redundancy in a Serial ATA storage enclosure.

Serial ATA is a new emerging disk connection standard,  
designed to replace the ATA (aka IDE (Integrated Drive  
Electronics)) connection inside standard personal  
10 computers (PCs). This technology may also be suitable  
for use in a storage enclosure.

Referring now to Fig 1 there is shown a conventional  
connection between a host (eg PC, RAID controller or  
15 disk drive controller) and a Serial ATA disk drive.  
There are two serial data paths, one sending commands  
and data from the host to the drive, and one sending  
commands and data in the reverse direction. Each data  
path comprises a differential pair of signals.

20

It will be noted that if the host or disk controller  
fails then it is not possible to access the data on the  
disk.

25 Unlike Fibre Channel disk drives, serial ATA drives  
does not have redundant ports as they only have one  
port to connect to the host or disk controller. Since  
there is only one port and since serial ATA connections  
are point to point links there is no option for  
30 redundant paths to the disk drive.

Some solutions to this problem include:

- Making a Serial ATA disk drive with two ports, however, this requires an expensive customised disk; or
- Mirroring the data on all Serial ATA disks so that  
5 there is a redundant path to the data rather than the disk, however, this requires twice the number of disk drives.

The present invention provides a redundant path by the  
10 addition of some low cost chips housed on a circuit board in the storage enclosure.

Preferably, circuit board comprises a printed circuit board arranged to attach to the rear of the disk drive.  
15

Potentially all Serial-ATA disk drive enclosures could use this invention.

Embodiments of the invention will now be described with  
20 reference to the accompanying drawings, in which:

Figure 1 shows a conventional connection between a host and a Serial ATA disk drive;

25 Figure 2 shows a first redundant connection method according to the invention;

Figure 3 shows a second redundant connection method according to the invention; and

30 Figure 4 illustrates a physical implementation of the invention.

When describing embodiments of the invention, it will be noted that, for clarity, all the diagrams only show a single disk drive, while in reality there would be many drives.

5

Referring now to Figure 2, there are two hosts (or disk controllers). These may be fixed or removable. If one fails then the data on the disk can be accessed by the other. When Host A is active Mux A is configured to  
10 send data from Host A to the disk, and Mux B is configured to send data from the drive back to Host A. When Host B is active Mux B is configured to send data from Host B to Mux A and Mux A is configured to send the data to the drive. Thus a malfunctioning host can  
15 be bypassed completely.

Host A and B also communicate by some other means (eg RS232, Ethernet) and agree which of them is going to communicate with the disk at any time. A redundant  
20 scheme exists between the hosts to allow them to operate in a highly available manner, including the so-called STOMITH (Shoot The Other Machine In The Head) method.

25 Hosts A and B jointly control Mux A and Mux B in such a manner that if Host A is not present or is not working properly then Mux A and Mux B are switched so as to put Host B in control of the drive, and vice versa. This could be achieved using signals from the Hosts in  
30 conjunction with pull-up or pull-down resistors.

Referring now to Figure 3, which shows an alternative way of implementing the invention. In this case the

data from the disk drive is fed to both hosts via some buffering. In certain controlled situations the buffer may not be necessary but is shown here for completeness. Both Hosts receive the data from the disk  
5 drive but the inactive one ignores it.

The embodiments outlined in Figs 2 and 3 could be implemented in several ways, for example, the muxs and buffers could be on the hosts, on the backplane or on a  
10 small board between the backplane and the disk drive.

Fig 4 shows the latter case as an example. In Fig 4 a single disk drive is shown, together with a small PCB which is mounted on the rear of it. When the disk drive  
15 is removed the PCB comes with it, thus allowing the backplane to be a completely passive board with no active devices on it, thus making it more reliable and easier to service. In this example the hosts are shown as removable boards. The dashed line indicates the  
20 communication between the two hosts, as mentioned above.

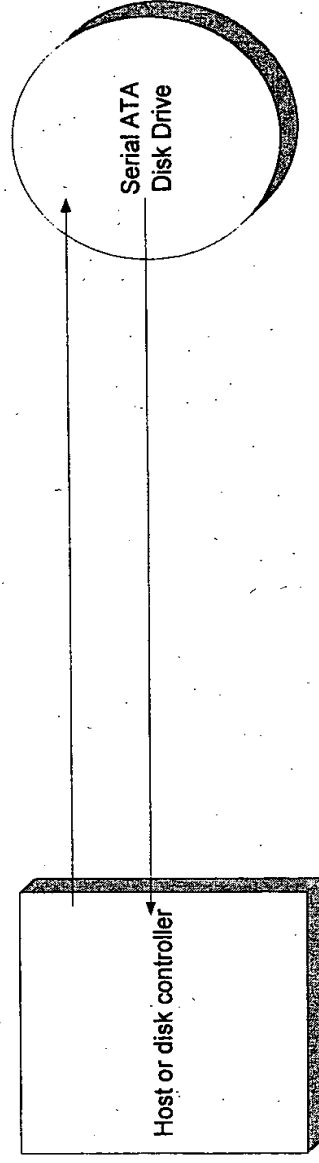


Figure 1 (Prior Art)



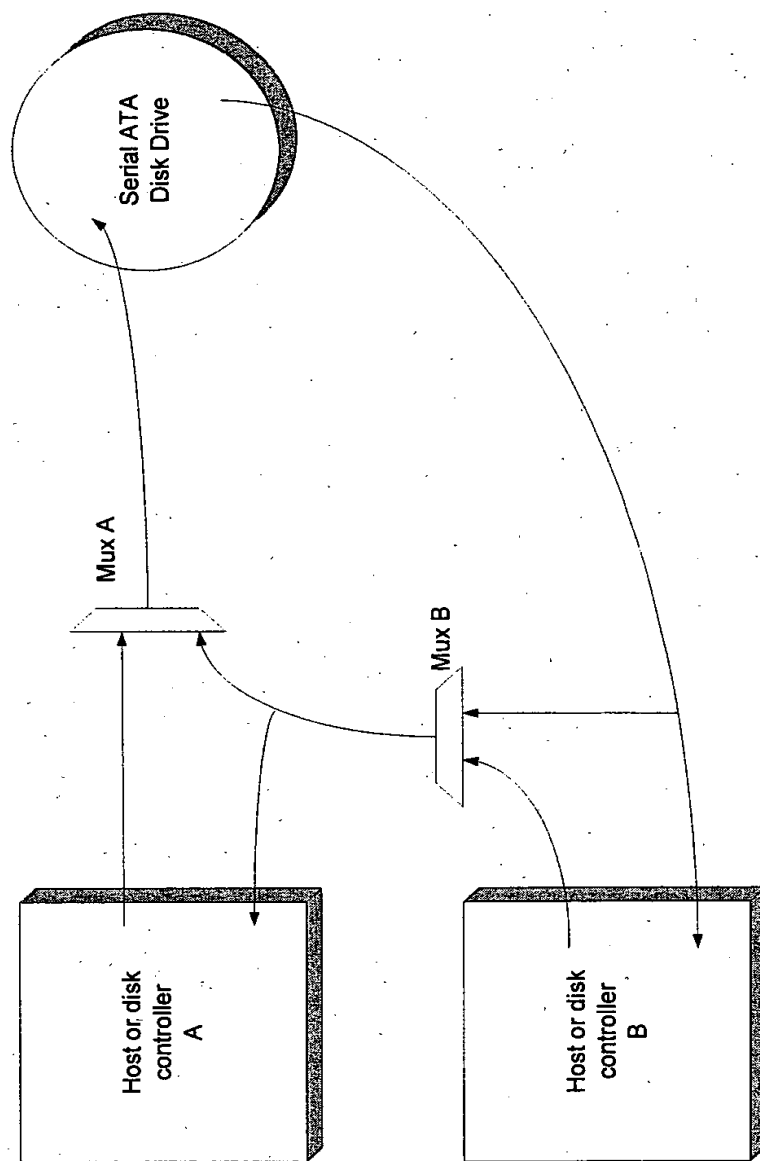


Figure 2

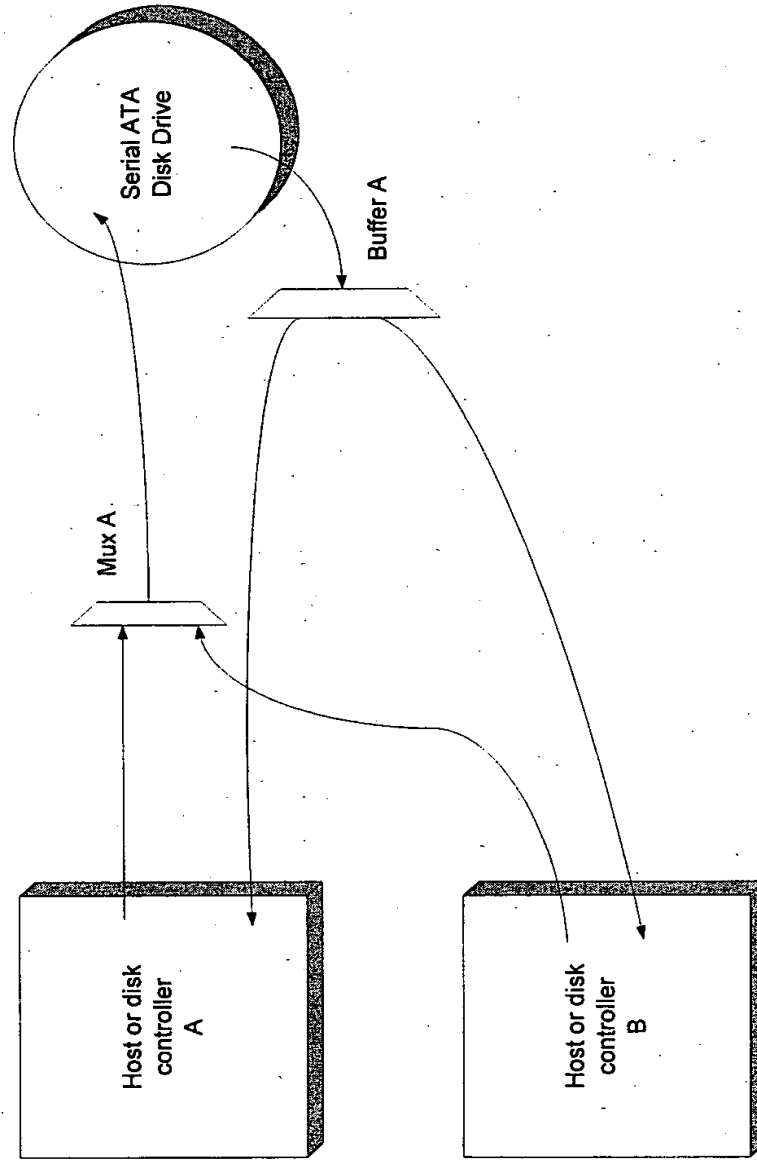


Figure 3

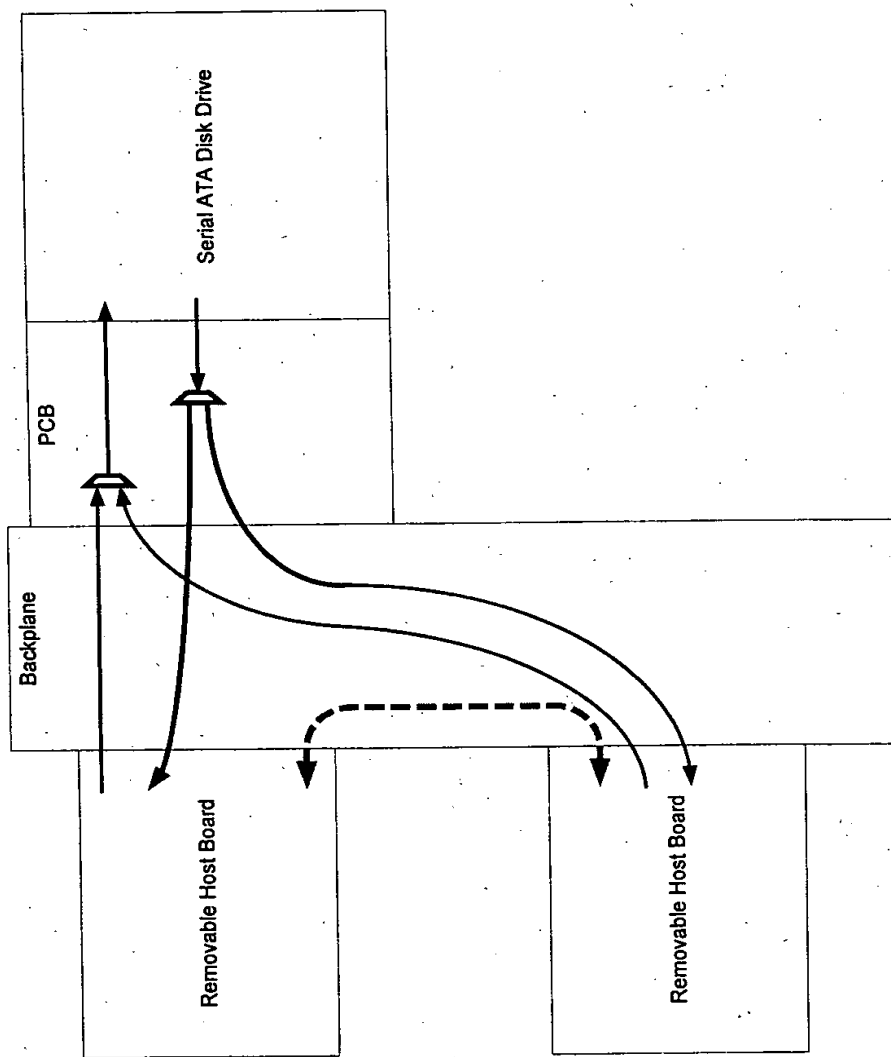


Figure 4